The Occupational Outlook

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UNITED STATES DEPARTMENT OF LABOR
BUREAU OF LABOR STATISTICS
in cooperation with
VETERANS ADMINISTRATION

The Occupational Outlook

UNITED STATES DEPARTMENT OF LABOR

James P. Mitchell, Secretary

Bureau of Labor Statistics

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This publication is issued to provide counselors with current information on employment trends and outlook, based primarily on the continuous research and statistical programs of the Bureau of Labor Statistics. It supplements and brings up to date information in the Occupational Outlook Handbook, and supersedes the Occupational Outlook Review, formerly prepared for the Veterans Administration by the Bureau of Labor Statistics. It is prepared with the advice and assistance of the

Bureau of Employment Security
Robert C. Goodwin, Director

Bureau of Apprenticeship and Training
W. C. Christensen, Director

Women's Bureau
Alice K. Leopold, Director

Bureau of Labor Standards
Paul E. Gurske, Director

of the

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Harvey V. Higley, Administrator

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Prepared under the supervision of Stella P. Manor in the Division of Manpower and Employment Statistics, Seymour L. Wolfbein, Chief

The Creative Manpower Shortage

Summary of an address by Rocco C. Siciliano, Assistant Secretary of Labor, at the 1956 National Convention of the American Statistical Association.

What do we mean by "creative manpower"? If this question had been asked a generation or so ago, the almost universal answer would have been: The artistic and literary professions--writers, sculptors, painters, composers, and the like. Today, it is a sign of our science-oriented age that engineers and scientists are the ones who first come to mind when we begin to talk about creative manpower.

The term creative manpower cannot be limited to engineers and scientists alone. It is true that our national security, as well as the continued expansion of our economy, depend in a substantial way on new scientific discoveries and their engineering applications. However, this should not overshadow the basic importance to our national welfare of the creative manpower needed in medicine, in teaching, in public administration, in the law, and so on.

Creativeness is needed throughout the occupational structure; it is not the unique need of any one occupational group. Where do we need creative talent more than in teaching, with its enormous impact on the growing individual? Or among skilled workers who translate ideas and blueprints into actual forms for the factory production line? Or among the executive and managerial group? Or on the farms where we now have the same number of persons as we had in 1870 producing an enormously increased amount of food for growing populations both here and abroad?

Creative manpower represents those individuals who, through their innovations, help us advance toward a higher standard of living and a higher level of national security. These individuals exist and are needed at every level of our society across the entire occupational structure. The innovations are seldom of the headline-making variety. More often they are small evolutionary changes which, step by step, help us advance toward our goals. Employee suggestion award systems, which have contributed substantially to increased efficiency in government and industry, testify to the presence of creativeness and originality in all occupational groups.

The term "shortage" also needs explanation. Many articles about "manpower shortages" appear in our newspapers and other periodicals. In this connection, it is worthwhile to remember that the United States has had manpower shortages throughout practically all of its history. Only during the 1930's was there any really long period

of unemployment in the United States. This has been a country of enormous growth and change, building up an industrial plant of great technological efficiency, absorbing millions of persons from abroad, and supporting a steadily growing population in an ever-increasing standard of living. How then does the current period differ from previous eras in our history?

The key to our problem today is the quality of our labor force. There are, of course, numerical shortages in many occupations; in research and development, in teaching, in clinical psychology, and in many technical, clerical, and skilled occupations. However, in every occupational field there is great need and demand for people at the top levels of knowledge, skill, and creativeness.

When we use terms like "creative manpower" we are trying to emphasize our critical need for better qualified personnel in our labor force. Our emphasis on quality arises from the very heavy demands made on our economy in this unparalleled period of change. We have, on the one hand, a significant period of technological advance where we are actually crossing new thresholds in the sciences. Accompanying this technological advance is an equally unprecedented period of international stress. To help us move through this great period of change we must have quality, creativeness, and leadership in increasing proportions of our work force.

Assuming a continuation of the basic trends apparent in this country during the first half of this century, what will the occupational structure look like in 1975? The expectation is for an increase of about 55 million in the population--the equivalent of a nation the size of Great Britain. This expansion would generate an increasing demand for consumer goods, housing, highways, and capital investment. Assuming productivity increases of the kind we have had up to now, a doubling of the gross national product is projected. These developments will call for an expansion of a little more than 20 million jobs between 1955 and 1975.

What kinds of changes in our occupational structure will these 20 million additional jobs bring? The accompanying chart presents some of the major changes. If previous trends continue, our projections show that professional personnel may hit the 10 million mark by 1975, accounting for 1 out of every 8 workers--almost triple the proportion in 1910. There is real need for expansion in many of the important groups in this field. The 1 million workers in engineering and science, the 1-1/2 million in teaching, and the 1 million in medical services (doctors, dentists, nurses, etc.) will undoubtedly all increase sharply and account for a major part of the expansion in professional employment over the next two decades.

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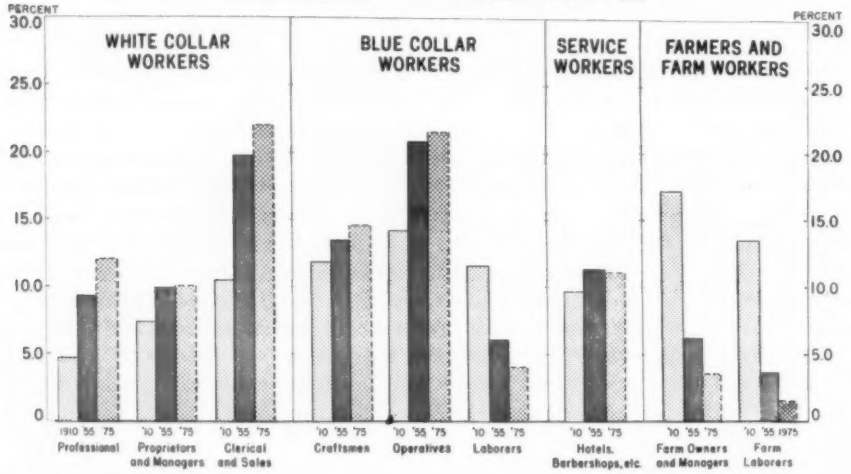
The two other groups comprising the white-collar occupations are also expected to increase--particularly the clerical and sales people, who already account for 1 out of every 5 people in the labor force today. Altogether, the white-collar occupations today represent the single largest group in the labor force and they are expected to be well out in front by 1975. A few years ago we reached the point where there were (and still are) more people employed in industries producing services than in those producing goods. Now, the occupational distribution has reached the same stage. Today, we have more white-collar than blue-collar workers in the American labor force.

Another important group which is expected to expand in both absolute and relative terms are the skilled and semiskilled industrial workers. The largest increases are expected among the building trades, the metal trades, and the skilled mechanics and repairmen.

On the other hand, decreases are expected in unskilled industrial labor and in the farm segment of the economy. If past trends and current technological developments, such as automation, are indicative, we may expect an actual decline in employment in these occupations in spite of a 20-million increase in the total number of jobs.

All of this seems to add up to a continued and persistent increase in the skill level of the labor force--in the number and proportion of workers requiring extensive education, training, and skill development--in the number of quality personnel we call creative manpower. Only through advances in our educational systems, our training programs on the job and in our schools, and in our skill development techniques can the creative manpower shortage, as it exists today and as we anticipate it will exist in the future, be effectively met.

EMPLOYMENT IN THE MAJOR OCCUPATIONS
1910, 1955, AND PROJECTED 1975
PERCENT OF TOTAL WORKERS ENGAGED IN EACH FIELD



UNITED STATES DEPARTMENT OF LABOR
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Source: U.S. Department of Commerce, Bureau of the Census and U.S. Department of Labor, Bureau of Labor Statistics

Employment Outlook for Clerical Occupations

Note: This is a preliminary version of a statement prepared for the 1957 edition of the Occupational Outlook Handbook.

The clerical workers who take care of the vast amount of correspondence, recordkeeping, and other office duties necessary to the operation of modern businesses and government agencies are one of the largest occupational groups in the United States. About 1 out of every 8 persons at work in the country in 1956 was in a clerical or closely related job. Altogether, about 9 million men and women were employed in occupations classified by the Bureau of the Census as "clerical and kindred."

Nature and Location of Clerical Work

The major clerical occupations are shown in table 1. Stenographers, typists, and secretaries--by far the largest group of clerical workers classified separately by the Census--totaled about 1-1/2 million in 1950. Bookkeepers were the second largest group with more than 700,000 workers. Other clerical occupations with more than 100,000 workers include those of telephone operator, shipping and receiving clerk, cashier, mail carrier, and office-machine operator.

Many officeworkers are designated simply as "clerks." There are also large numbers in clerk positions with more specific titles which indicate the type of work done--for example, file clerk, billing clerk, credit clerk, time clerk, payroll clerk, or postal clerk. These clerks and many others who were not classified separately by the Census made up more than one-third of all clerical employees in 1950.

Clerical work is the largest of all areas of employment for women. In 1956, about 1 out of every 4 employed women was an office-worker. The number and proportion of women in clerical occupations have been rising steadily over the years. Women outnumbered men in these occupations for the first time in 1940, and by 1956, two-thirds of all clerical workers were women. More than 90 percent of the telephone operators; the stenographers, typists, and secretaries; and the attendants in physicians' and dentists' offices are women. Women also fill more than three-fourths of the jobs as bookkeepers, cashiers, and office-machine operators. Only in one large occupation--office-machine operator--was there a rise from 1940 to 1950 in the proportion of men employed. Nevertheless, about 3 million men were employed in clerical and related work in 1950. More men than women were working as

shipping and receiving clerks, mail carriers, bank tellers, ticket agents, messengers, and telegraph operators, as well as in many smaller occupational groups, such as vehicle dispatchers, bill collectors, railway mail clerks, and baggagemen.

Clerical workers are employed in all industries, since some office work is essential in nearly every business. However, an increasing proportion of clerical workers are employed in finance, service, and related industries--principally in banks, insurance and real estate companies, and in professional and business services. More than one-fourth of all officeworkers were employed in this group of industries in 1956, whereas only a little more than one-fifth of such workers were employed in manufacturing. Wholesale and retail trade, government, and transportation, communication, and other public utilities also employed large numbers of clerical workers.

Clerical jobs are to be found in the smallest of towns--everywhere that business is carried on. However, the great concentration of employment is in the largest cities where the central offices of insurance companies, banks, and corporations are located or where large government offices are established.

Training and Other Qualifications

Graduation from high school is the usual minimum educational requirement for entering clerical jobs. Additional business courses or some college work may be required for jobs requiring specialized skill. The most widely sought office skills--stenography and typewriting--may be obtained either through high school or business school courses. Ability to do some typewriting is an asset in qualifying for most types of clerical work. The operation of many kinds of office machines, such as adding machines, special bookkeeping machines, and billing machines, is often taught on the job. A good many large firms offer training courses in the use of equipment such as telephone switchboards, dictating machines, or electric typewriters, and a few firms finance business school training for employees on company time if they agree to stay on for a stated period of employment. Many companies participate in work-study programs with local high schools; pupils who have been in such programs usually are given preference when seeking employment. Some employers give aptitude and other tests to applicants for office jobs. Reading comprehension, numerical skill, and good knowledge of spelling and grammer are important in obtaining a job and essential to advancement. A good personality and ability to get along with others are rated high in qualifications necessary for success in office work.

College graduates often enter clerical occupations to gain experience in a particular industry or business and later work up to professional or administrative positions. Young people who enter with little

education may never advance far and may leave for other types of jobs. However, companies often prefer to hire people with only minimum qualifications for clerical positions, since they are more likely to be satisfied with and remain on jobs of a routine nature than are persons with more advanced training.

Promotion from a beginning clerical job may be first to a minor supervisory position and then to that of section head. Many preferred jobs--secretary, information clerk, customer-relations clerk, and others requiring a general knowledge of company policies and procedures--are frequently filled by promotion from the ranks of clerks and typists. Although seniority is an important consideration in selecting clerks for promotion and transfer, great emphasis is placed on the individual's ability and personal qualifications for the new job.

Employment Outlook

Large numbers of openings will occur each year in clerical occupations. Most of the employment opportunities will result from employee turnover, which is exceptionally high in this field. A 1955 survey of several hundred firms with office staffs ranging from fewer than 50 to more than 1,000 workers indicated an average annual turnover rate of 40 percent, about half of which resulted from young women leaving their jobs to marry or care for their children. In addition to the many jobs expected to become available because of continuing high replacement rates, a number of new opportunities are likely to result from employment growth.

The shortage of clerical workers--particularly of stenographers and secretaries--which had been evident in most cities for several years was still pronounced in 1956. Many business firms were hiring people who in previous years when more workers were available would have been considered unsuited for office work. These included persons in the older age groups, high-school-age youths, and handicapped workers; many were employed on a part-time basis. In general, employers were well pleased with these workers and are likely to continue to recruit from their ranks. The extensive use of older women is indicated by the rise in the median age of women officeworkers from 31 years in 1951 to 33 years in 1956.

A rapid rise in the number of clerical workers and in the proportion these workers represent of the total working force has been a marked feature in the growth of American industry over the years. In 1910, only 1 in 20 American workers was engaged in clerical work. By 1940, the proportion of clerical workers had risen to 1 in 10 and, in 1950, it was 1 in 8 employed workers. In 1956, the proportion of clerical workers was a little higher than in 1950.

The remarkable increase in employment of clerical workers has taken place despite--sometimes even because of--the introduction of new laborsaving equipment and more efficient management methods. For example, the dial telephone, far from slowing down the growth in the number of telephone operators, stimulated the use of telephone services and increased the demand for telephone operators, so that their numbers rose faster between 1940 and 1950 than the number of clerical workers as a group. Similarly, the introduction of electric typewriters, duplicating equipment, machines to take dictation, and other improvements in methods of writing and copying letters and reports failed to halt the rise in employment of secretaries, stenographers, and typists whose number rose by 50 percent between 1940 and 1950. Only in a few small clerical occupations, such as bill collector, messenger, and telegraph operator, was there a decline in numbers during this decade.

Underlying this growth has been the tremendous increase in the size and complexity of business organizations, which has added greatly to the volume of recordkeeping and communication required. Centralized management services have been established to aid in the control and coordination of these enlarged organizations, and this has brought about expansion in such areas as advertising, research, accounting, personnel administration, insurance, and employee benefits. These activities have added vastly to the amount of paperwork involved in business management. At the same time, the greater volume of tax and other reports to government agencies further increased the amount of office work required of industry, and has also greatly increased clerical work in government offices.

In the near future and over the long run, clerical employment is likely to continue to rise owing to the same factors that have brought about previous increases. However, industry has begun to make a determined attack on the problem of clerical costs and is introducing new equipment designed to handle a rising volume of work without a corresponding increase in the number of clerks required. A few large insurance companies, banks, and industrial firms had already installed electronic data processing equipment by 1956 and thereby reduced their need for clerks in many routine operations. Although these machines have created a number of new jobs, many of which require considerable skill and are relatively well paid, their net effect is a reduction in the number of clerical workers needed to perform a given volume of work. However, electronic data-processing machines are expensive and complicated and it will doubtless take a number of years before they are widely used, even in the very large organizations able to buy and effectively use them. It is probable that a more important factor affecting employment of clerical personnel will be the more widespread use in small firms of the less expensive types of office equipment, such as improved bookkeeping machines, calculators, adding machines, and

Table 1.--Employment in major clerical occupations, 1950
(Thousands of workers)

Occupation	Total	Men	Women
Stenographers, typists, and secretaries	1,589	88	1,501
Bookkeepers	721	165	556
Telephone operators	358	16	342
Shipping and receiving clerks	284	264	20
Cashiers	226	43	183
Mail carriers	165	162	3
Office-machine operators	142	25	117
Bank tellers	64	35	29
Ticket agents	59	52	7
Messengers and office boys	55	45	10
Attendants, physician's and dentist's office	41	2	39
Telegraph operators	34	27	7

Source: U. S. Bureau of the Census.

photographic and other duplicating equipment. Whereas the use of these machines increases the employment of certain types of office personnel (mainly office-machine operators), their net effect is the accomplishment of more work with fewer people.

Taking into account the basic growth factors in the clerical field and the efforts of business to reduce clerical costs by the use of more automatic equipment and other means, it appears likely that employment in clerical occupations will continue to increase, but at a slower pace than during the past several decades. There is already some evidence of a slowing down. If the number of clerical workers had continued to rise as rapidly after 1950 as it did in the previous decade, the total number of clerical workers in 1956 would have been nearly 10 million, compared with an actual total of somewhat less than 9 million. Furthermore, the rise in the number of clerical workers has been due in part to increased employment of part-time workers. For example, between October 1955 and October 1956, more than three-fourths of the increase in total employment was accounted for by part-time workers.

Employment opportunities in the clerical field may be greatly affected by changes in the level of business activity. There are usually plenty of people in the labor force with the qualifications needed for most office jobs. However, the comparatively low salaries offered limit the number of applicants when other jobs are available. On the

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other hand, when business activity declines keen competition is likely to develop, since the supply of workers available for clerical employment is increased by displaced workers from many other occupations.

Earnings and Working Conditions

The most common hiring-rate range for inexperienced clerical workers, including typists, was from $40 to $42.50 a week in the winter of 1955-56, according to a survey of earnings in 17 labor market areas by the U. S. Department of Labor's Bureau of Labor Statistics. The highest paid officeworkers were men classified as accounting clerks (class A) whose average weekly salaries ranged from $75 to $95.50 a week. Among women officeworkers, secretaries were generally the highest paid, with salaries ranging from an average of $61.50 in Providence, R. I., to $81 in Detroit, Mich. Accounting clerks (class A) usually were the second highest paid among women officeworkers. Average salaries of women in the major office occupations in the 17 labor market areas surveyed are shown in table 2.

Officeworkers in Detroit and in the Los Angeles-Long Beach area received the highest average salaries, about 6 percent more than the salaries paid in New York City. New Orleans officeworkers received the lowest salaries, on the average--about 20 percent less than those in New York City.

Pay levels for officeworkers tend to be higher in manufacturing than in most nonmanufacturing industries. However, salaries in public utilities frequently exceed those in manufacturing establishments.

TABLE 2.—*Average weekly salaries for women in 13 office occupations, 17 areas, winter 1955–56*

Area	Bookkeeping-machine operators, class A	Bookkeeping-machine operators, class B	Clerks, accounting, class A	Clerks, accounting, class B	Clerks, file, class B	Clerks, payroll	Comptometer operators	Key-punch operators	Office girls	Secretaries	Stenographers, general	Typists, class A	Typists, class B
Northeast:													
Newark-Jersey City	$62.00	$54.00	$71.50	$58.50	$47.50	$63.50	$63.50	$58.50	$45.00	$75.50	$61.50	$58.50	$51.00
New York City	66.00	59.00	73.50	58.50	49.00	68.00	63.50	57.50	46.00	78.50	63.00	61.50	53.50
Philadelphia	61.00	49.00	64.00	52.00	41.00	58.50	54.50	54.00	41.00	70.50	56.50	54.00	46.00
Providence	56.00	49.50	58.50	49.50	42.50	52.50	51.00	49.00	42.00	61.50	51.50	50.50	45.00
South:													
Atlanta	60.00	54.50	68.00	53.50	44.50	58.50	57.00	53.50	44.50	71.00	59.50	53.50	47.00
Dallas	62.50	51.50	64.50	54.00	40.50	58.50	56.50	52.50	41.00	70.00	60.50	54.00	46.50
Memphis	60.00	51.00	64.00	51.00	42.50	56.50	51.50	53.00	42.50	62.50	54.00	54.00	43.50
New Orleans	58.00	46.50	68.00	50.50	41.50	54.00	51.00	52.00	36.50	67.50	54.50	49.50	42.00
Middle West:													
Chicago	73.50	62.00	76.00	61.00	51.00	68.50	65.50	63.50	51.50	78.50	66.50	65.00	55.50
Detroit	73.00	58.50	78.00	60.50	48.50	70.50	67.00	64.50	49.50	81.00	69.50	67.00	53.50
Milwaukee	66.00	54.50	69.50	56.00	46.50	59.50	55.50	55.00	43.50	74.50	58.50	58.00	48.50
Minneapolis-St. Paul	62.00	52.00	66.50	52.00	44.00	59.00	57.00	50.50	41.50	68.50	56.50	54.00	47.50
St. Louis	61.50	53.00	70.00	54.00	45.50	60.50	58.00	57.00	47.00	73.00	59.00	58.50	49.50
Far West:													
Denver	65.50	51.50	63.50	55.00	45.50	59.00	54.00	56.50	43.00	70.50	59.50	55.50	48.50
Los Angeles-Long Beach	75.00	57.00	76.00	64.00	52.00	72.50	68.50	67.50	52.00	79.50	68.00	64.00	55.00
Portland	69.50	55.50	74.00	60.50	48.00	64.00	61.00	62.00	45.50	75.00	63.00	60.00	51.00
San Francisco-Oakland	74.00	58.50	75.00	62.00	50.00	71.00	65.00	63.00	52.00	79.00	68.50	62.00	54.00

The most usual work schedule for full-time officeworkers in the cities surveyed was a 5-day week of 40 hours. About two-thirds of the women officeworkers in finance, insurance, and real estate offices worked less than 40 hours a week. In New York City, where a high proportion of all clerical workers are employed in such offices, 7 out of 8 women officeworkers had a workweek of less than 40 hours--most typically 35 hours.

Officeworkers usually receive at least 6 paid holidays a year and 2 weeks' paid vacation after a year's employment. Related benefits usually include life insurance, hospitalization and surgical insurance, pay continuation in case of accident or illness, and some type of retirement pention plan.

Now Available

EMPLOYMENT AFTER COLLEGE: REPORT ON WOMEN GRADUATES, CLASS OF 1955

Results of a mail questionnaire survey conducted by the Women's Section of the National Vocational Guidance Association and the Women's Bureau of the U. S. Department of Labor. The survey showed what these women were doing in the winter of 1955-56, how much they were earning, and the relationship between their jobs and their college majors.

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price 25 cents.

Employment Outlook for Electronics Manufacturing Occupations

Note: This is a preliminary version of a statement prepared for the 1957 edition of the Occupational Outlook Handbook.

Electronics manufacturing is one of our most dynamic and rapidly growing industries. Employment in the industry more than doubled between 1947 and 1956, and approximated 450,000 in mid-1956. An additional 40,000 workers were engaged in the development and manufacture of electronics products in other industries, particularly those making aircraft and business machines.

Electronics products, such as radio and television, are found in nearly every home. Many other electronics products, less familiar to the average person, are widely used in manufacturing processes and commercial activities. Electronics products are also vital to the national defense. For example, electronics equipment is an integral part of every piloted aircraft, guided missile, and ship. It is essential to military communications and it is the heart of the radar network set up to give warning in case of enemy air attack. Another important aspect of the industry is its large-scale research and product development activity which creates a constant flow of new and improved electronics products for home, industry, and defense.

The electronics industry provides job opportunities for persons with widely different levels of skill and education. Some jobs in the industry can be learned within a few weeks; others can be filled only by persons with university graduate training in science.

Nature and Location of the Industry

Before World War II, this industry was generally known as the radio industry. Its principal products were radios, broadcasting equipment, other receiving and transmitting equipment, parts, and electronic tubes. However, with the rapid development of other products in the general field of electronics, the broader term "electronics manufacturing" has come into general use. The electronics manufacturing industry consists of those plants engaged in producing electronics products or their components. The industry may be divided into four major product groups: (1) Radio and television sets and other consumer products, (2) military and industrial equipment, (3) radio and television tubes, and (4) components such as capacitors and transformers. The industry produced more than $6 billion worth of goods in 1955. Military and industrial equipment accounted for $2.6 billion; consumer products, $1.6 billion; components, $1.4 billion; and tubes, $.7 billion.

Household television and radio sets are the most widely used consumer electronics products. The industry produces other consumer products, such as hearing aids, phonographs, high fidelity equipment, recorders, and electronics stoves. Another major group of products are electronics instruments for controls, counting, and inspection. In highly mechanized or automated plants, these electronics devices are used for the automatic control of machinery. In chemical processing plants, they are used for checking properties of liquids and gases, for flow control, and for measurement. Electronics computers are finding application in many industries. Science also relies on electronics equipment. Many devices used by medical science and by many branches of physics are electronic. Electronics microscopes and electronics telescopes have been particularly valuable in expanding the frontiers of knowledge.

A great variety of electronics equipment is used in military products. Airborne electronics systems are essential for controlling guided missiles, aircraft flight control and navigation, communications, and weapons fire control. Radar, proximity fuses, and mine detectors are other important military products.

Many companies are engaged solely in producing radio and television tubes which they sell to other firms. Similarly, there are many plants which produce one or a few component parts which are used in other plants in the final assembly of electronics products.

Electronics manufacturing plants are located in 24 States and the District of Columbia. The States with the largest number of electronics workers in mid-1956 were California, Illinois, Massachusetts, New Jersey, Pennsylvania, and New York. The metropolitan areas with the highest concentrations of employment were: Boston, Chicago, Los Angeles, New York, Paterson-Passaic, Philadelphia, and San Francisco. Many of the newer plants in this industry are located in suburban and rural areas.

How Electronics Products Are Made

The wide range of products manufactured and the considerable variation in production techniques make it difficult to generalize about the manufacturing process in this industry. Some companies produce most of the components they use, whereas others primarily assemble parts produced by other firms. The principal peacetime electronics products are mass produced. However, some complex specialized military, commercial, and industrial equipment and components are made to order in small quantities.

Most plants in the industry specialize in manufacturing one end-product, such as television sets, radios, computers, guided missiles, or instruments; or one type of component, such as resistors, antennas,

capacitors, coils, or tuners. Even where plants do produce more than one kind of product, each product is generally produced by separate departments and on separate assembly lines.

Research and development are often kept apart from production, particularly in larger firms. Very often these activities are located at completely separate sites. When research and development and production are under one roof, they are often not closely connected, except in pilot stages of production where engineers are attempting to adapt the design of a product to quantity production.

Although electronics plants are primarily engaged in assembly, many of these plants have parts fabricating and processing departments. For example, many plants have machine shops, electroplating shops, sheet metal shops, cleaning and coating sections, and wire fabricating departments.

The following is a brief description of the manufacturing methods used in producing radio and television receivers--major electronics products. Radio and television receivers are made on assembly lines where each worker rapidly performs a highly specialized task. All assembly operations are carefully timed to maintain a continuous production flow. The majority of receiver manufacturers purchase the parts and tubes used in the assembly operations from other manufacturers.

In general, receivers in various stages of completion move down the assembly line, which may be a continuous moving belt or simply a long bench upon which sets are pushed from one worker to another. The chassis (the metal box to which most components are attached) is usually stamped out of sheet metal and some parts are riveted to it in a subassembly line. After the chassis is prepared, it starts down the main assembly line where other parts are attached, wired, and soldered. At frequent intervals, it is inspected and tested for proper assembly and electrical wiring. The periodic testing and inspection of a product to see if it is being made according to specifications is extremely important in electronics manufacturing and increases with the complexity of the product.

As the chassis moves down the assembly line, parts are placed or timed to reach the assembler when needed. Small parts are often "hopper fed" into boxes by the side of the assemblers. Large parts move by overhead conveyor or are carted, depending upon the size of the plant or the quantity ordered. Some assemblers attach small parts, and others add wires or solder connections. Operations are subdivided as much as possible and workers are assisted by models, diagrams, and color coding of parts and wires. The degree of specialization depends upon the size of plant and type of product.

At the end of the line, tubes are added and the receiver is adjusted and tested as a unit. Inspectors and testers check its quality and, in some television firms, operate it for a while to see if defects develop.

Electronics equipment more complex than receiver sets is produced in smaller quantities, with similar production techniques but with less mechanization and worker specialization as the unit volume declines. Custom-made products require more skilled labor. Large military and commercial units which are often very complex are broken down into subassemblies which are built separately and then assembled and tested as a unit. Many types of military equipment operate on extremely high frequencies where radio waves have properties similar to light waves. The electrical adjustment of such equipment is extremely critical and the equipment therefore requires precision manufacture. Some of the components associated with radar, such as metal waveguides, must be machined or cast with the greatest precision.

The assembling of military equipment is quite different from the assembling of receivers. Assembly workers on military electronics products perform more operations and must be able to follow more detailed diagrams and instructions. Because accuracy is more important than speed, the work pace is not as rapid as in the assembling of receiver sets.

The manufacture of standard parts, such as capacitors, resistors, transformers, and coils, is on a large-volume, mass-production basis, and usually involves relatively simple production processes.

Occupations in Electronics Manufacturing

As indicated previously, the industry employed persons with widely different skill and educational levels among its 450,000 workers in mid-1956. In the industry as a whole, about 27 percent of the workers were employed in nonproduction jobs. Included in this group were professional and technical personnel, supervisory workers, and administrative and office employees. About a third of all nonproduction workers were employed in research and development activities. The proportion of nonproduction workers differs among the various sectors of the industry depending upon the type of product being manufactured and the amount of research and development work being carried on. For example, more than 30 percent of the workers in plants manufacturing some military products were nonproduction workers, whereas they constituted about 20 percent of the employees in radio and component parts plants.

Production workers comprised 73 percent of the industry's employment as shown in the following tabulation which gives percentage distribution by major occupational groups of workers in the industry in March 1956. Assembly workers, the largest occupational group in the industry, accounted for 30 percent of the industry's employment. Inspection and testing personnel made up about 14 percent of all workers; machining, 7 percent; and other fabricating, 6 percent.

Occupational group	Percent of workers
Total employment	100.0
Nonproduction workers	26.9
Managerial and supervisory	4.4
Research and development	10.0
Professional	4.1
Technical	3.0
Craftsmen	.8
Other	2.1
Other professional	2.3
Office	9.2
Accounting	2.0
Other, including sales	7.2
All other nonproduction workers	1.0
Production workers	73.1
Assembly	30.5
Machining	7.1
Other fabricating	5.6
Processing (coating, plating, and cleaning)	2.4
Inspection, testing, and related	13.7
Materials handling	4.1
Plant clerical	1.3
Maintenance	3.7
Custodial	2.1
All other production workers	2.6

About half of the industry's workers are women, most of whom are employed in semiskilled production jobs and office work. However, there are opportunities for women in nearly all types of positions. The proportion of women varies among the different manufacturing sectors of the industry. For example, women make up more than 60 percent of the employees in tube and components plants, whereas they comprise less than 45 percent of the employment in plants manufacturing military and industrial equipment.

Professional and Technical Jobs

A large proportion of professional and technical jobs are held by engineers. The industry also employs many scientists, draftsmen, and engineering aids. About 1 out of every 18 of the industry's employees is an engineer--a much higher proportion than is found in most other manufacturing industries. This is the result of the industry's emphasis on research and development. Most of the engineers in this industry are electrical or electronics engineers. They are employed mainly in research and development work and in the preparation of technical manuals. Others are engaged in production engineering, quality control, or in sales or customer consulting jobs.

The industry also employs mechanical engineers who design machinery and equipment used in electronics manufacturing. Industrial engineers design jigs and fixtures, make time and motion studies, analyze costs, and determine production methods. Ceramic engineers are employed by firms which use ceramics in their products.

Among the scientists employed are physicists, most of whom work in the development of military electronics equipment, such as guided missiles and other airborne apparatus. Chemists are employed in electronics plants mainly in research and development and materials testing. Electronics manufacturing firms also employ mathematicians, industrial designers, and metallurgists. Mathematicians work with engineers and physicists in solving complex mathematical problems. A few operate electronics computers. Industrial designers determine form and design of electronics products to make them more acceptable to consumers. Metallurgists are concerned with heat-treating problems and the properties of metals under stress and varying temperatures.

The industry employs several thousand employees in semiprofessional jobs to assist engineers and scientists. The largest group are the draftsmen who are usually employed in engineering departments where they prepare drawings from sketches or specifications furnished by engineers. A higher proportion of draftsmen are required for military electronics production than for the manufacture of other types of electronics products.

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Another important group of semiprofessional workers are the engineering aids who assist engineers in research and development and in production planning by making calculations, tests, and rough drawings. They may also keep a check on pilot lot-production and mockup (model) work. Aids frequently act as liaison men with other sections and departments.

Technical writers are employed mainly in plants making military and industrial products. The writers prepare technical manuals describing the operation and maintenance of complex equipment, and training manuals to be used by military personnel and employees of industrial customers. Technical writers also prepare catalogs and product literature, and project reports and proposals. They may search technical literature in connection with their writing. They work closely with engineers.

Administrative and Office Jobs

About 11 percent of the workers in the industry are employed in administrative and office jobs similar to those found in other manufacturing industries. More than half of them are women.

Included among the administrative workers are accountants, purchasing agents, salesmen, personnel workers, and advertising personnel. Thousands of other white-collar workers are needed to help the administrative workers. Some of these are bookkeepers, secretaries, stenographers, clerks, and typists.

Plant Occupations

Almost three-quarters of the workers in the electronics industry were employed in plant jobs in mid-1956. Plant jobs can be conveniently classified into the following occupational groups: Assembly, machining and other fabricating, processing, inspection, maintenance, materials handling, plant clerical, and custodial. Some of the important occupational groups are discussed below.

Assembly Jobs.--Almost 1 out of every 3 electronics workers has an assembly job. Most of these jobs involve the performance of a single task. Some assemblers are engaged primarily in placing components in a chassis or other type of frame; others are engaged in connecting parts with electrical wires or in preparing parts for assembly. Most of these operations are performed manually with the help of a few handtools and perhaps some jigs for holding the work. In the mass production of television sets and similar products, printed circuits have made possible the use of automatic assembly equipment in the assembly process. Assemblers working on military and industrial electronics equipment are usually required to be more skilled than those who work in the manufacturing of radio and television sets.

In manufacturing radio and television sets, assembly workers perform repetitive operations, such as fitting and securing transformers, condensers, and resistors into a chassis. Other assembly workers are employed as solderers to join electrical connections by melting and applying solder, and as wirers to make connections between wires and mechanical joints.

Precision assemblers employed in the manufacture of military and industrial electronics equipment assemble a wide variety of precision units and subassembly units where numerous interrelated moving parts and mechanisms must operate within close tolerances. Experimental and developmental assemblers perform experimental and modification assembly, often from blueprints, sketches, or verbal instruction. Considerable independent judgment must be exercised in these assembly operations.

Most of the work in assembling television sets, radios, and military equipment produced in quantity is performed by women. In the mass production of electronics tubes and other electronics parts, nearly all assembly jobs are held by women. A larger proportion of men are used in the more technical assembly work which requires broader skill and experience. Practically all assembly of experimental or mockup models is performed by men. Men are also used for heavy assembly jobs.

Machining Occupations.--About 7 percent of all employees in electronics manufacturing are engaged in metal machining jobs. Almost every large plant in the industry employs these workers. Machine tool operators and machinists operate power-driven machine tools to produce metal parts of electronics components and equipment. Toolmakers construct and repair jigs, fixtures, and instruments used in electronics manufacturing. Diemakers specialize in making dies used in punch and power presses.

Inspection and Testing Occupations.--Electronics products are sensitive and finely adjusted instruments, and they must be inspected frequently during assembly and thoroughly tested before shipping. About 14 percent of all the industry's workers were working in inspection, testing, or quality control jobs in mid-1956. Inspectors check incoming parts received from other plants or parts produced in their own plants with the aid of devices, such as gages, to see whether the parts conform to specifications. Testers use electrical and electronics devices to check the performance of a product or component to make sure that it will do the job for which it was built. Final testing is one of the most important operations in the manufacture of electronics products and is done with special care for military products.

Most inspection and testing jobs are repetitive and require little skill. However, some of these jobs, particularly in final testing, require highly skilled workers. Some final testing of electronics end products is performed by electronic technicians.

Electronics Technicians.--Electronics technicians are skilled workers who work from wiring diagrams and blueprints and use the basic formulas, tables, charts, and manuals necessary for calculating circuit values. They also use testing and measuring devices, such as oscilloscopes, signal generators, and frequency meters. Many electronic technicians are employed as trouble shooters to locate the defective parts of electronics equipment. They also are employed as quality control inspectors, aliners, and phasers, and in other skilled testing and inspection jobs. Many electronic technicians work in research departments or engineering laboratories where they assist engineers in the construction and testing of experimental models. They may also design and make specialized test equipment.

Maintenance Occupations.--Almost 4 percent of all electronics workers are skilled workers employed in the maintainence and repair of the large amounts of machinery and equipment used in electronics manufacturing plants. Included among the skilled maintenance workers are electricians, carpenters, industrial machinery repairmen, painters, millwrights, and pipefitters.

Other Plant Jobs.--The electronics industry employs many other plant workers to fabricate and process parts, to move materials, to receive and ship materials, and to keep plant records. In addition the industry employs guards, janitors, and laborers.

Training and Other Qualifications

Because of the technical nature of its operations and great emphasis upon developmental work, the electronics industry requires many engineers and other technical workers. As indicated in the statements on individual occupations, a bachelor's degree in engineering from a recognized college is usually the minimum educational requirement for engineering jobs. Requirements for technical writers include a combination of writing ability and an engineering or science background. Although many technical writing jobs are filled by electrical engineers, individuals with English or journalism majors and some training or experience in scientific fields are also employed as technical writers. Several different avenues may lead to jobs as draftsmen in this industry. Some workers enter this occupation after studying at a trade school or technical institute; others learn the skills of the occupation by serving a 3- or 4-year apprenticeship, or through an informal arrangement combining on-the-job training and part-time schooling.

Electronics firms generally have the same requirements for filling clerical and administrative jobs as firms in other industries. Most electronics firms require commercial courses in high school or business school for office jobs such as clerks, bookkeepers, stenographers, and typists. More and more employers in this industry require college training for jobs in advertising, personnel, accounting, and other administrative jobs.

The training requirements for plant jobs range from a few weeks of on-the-job experience to 4 or 5 years of formal apprenticeship. Persons with no previous experience or training are hired for the great bulk of repetitive assembly jobs. The assembly jobs requiring greater skill are generally filled by persons who have had several years of experience in less skilled electronics assembly work. Finger dexterity, steady hands, and good eyesight are required for assembly jobs.

As in the case of assemblers, persons with no previous experience or training are hired for routine testing and inspection jobs. Some of the more difficult testing and inspection jobs are filled by electronics technicians. Some final testers are required to hold a license from the Federal Communications Commission as first- or second-class commercial radiotelephone operators.

Electronics technicians employed in testing jobs must be familiar with basic electronics theory, with circuits, and with the functions of many electronics components. Workers may enter this occupation in several ways. Some are upgraded to this job from lesser skilled jobs where they accumulated a broad knowledge and experience in electronics. They may also have had some classroom training in electronics theory and practice to supplement their experience. Other workers have learned this occupation in technical institutes or trade schools. In recent years training received in Armed Forces technical schools has helped many men qualify for civilian electronics technician jobs after leaving the service. Another method of entering the occupation is to serve a 4- or 5-year apprenticeship.

A 3- or 4-year apprenticeship, or its equivalent in experience, is generally required for skilled machining jobs, such as machinist or tool and die maker; and for skilled maintenance trades, such as electricians, millwrights, and industrial machinery repairmen.

Employment Outlook

The electronics industry will provide thousands of job opportunities for new workers in the late 1950's and the 1960's. This is expected to be one of the fastest growing manufacturing industries, and employment will increase at a much faster rate than the Nation's total labor force.

From inconspicuous beginnings shortly after the opening of the 20th century, the electronics industry has grown into one of the Nation's giant manufacturing industries. Employment in this industry began its rapid growth in the 1920's, when millions of radios were purchased as commercial radio broadcasting spread throughout the country. During the depression years, employment dropped briefly, but by the midthirties it reached a new high. The need of the Armed Forces for electronics equipment

brought about a tremendous expansion in the industry during World War II. At the peak of the war in 1944, about 300,000 wage and salary workers were employed, primarily in plants manufacturing military electronics equipment and components.

Employment dropped sharply after the end of World War II when military requirements for electronics equipment were greatly reduced. As electronics manufacturers shifted to the production of civilian items, employment increased. Since World War II, the trend of employment in this industry has generally been sharply upward, although the industry has experienced significant fluctuations in its level of activity. This postwar growth reflects new applications of electronics in consumer goods and industrial and military equipment. Television sets, electronics computers, electronics controls for industrial processes, and airborne electronics systems are some of the new products which have spearheaded the growth of the industry in recent years.

Continued rapid expansion in the industry can be expected during the late 1950's and the 1960's. All segments of the industry are expected to participate in the growth. An important factor influencing the growth of this industry is its constant emphasis upon research and development. Many new and improved electronics products for industrial consumers and for the military are expected to result from the industry's research activities.

The greater use of electronics products in manufacturing and commercial establishments offers the most promise for expansion. Substantial increase in the use of electronics control equipment is expected in metalworking, in chemical and petroleum processing, and in many other manufacturing activities. Greater use of electronics equipment is anticipated for communication and navigation purposes in aircraft, ships, railroads, and trucking. Indications are that data-processing equipment, which in 1956 represented only a small percentage of industrial and commercial electronics output, will grow rapidly and become one of the industry's important products.

In 1956, the bulk of sales of electronics products to consumers consisted of television and radio sets, and it is likely that they will be the principal consumer products of the industry in the 1960's. However, the increased use of other electronics products already in use and the development of new products will greatly expand the output of consumer electronics items. Some products which are expected to provide substantial future sales for the electronics industry are automobile equipment; cooking equipment; refrigerators; air conditioners and heaters; intercom and high fidelity systems; and lighting.

More than 40 percent of the industry's income in 1955 was from activities relating to national defense. This included both production of military items and research and development contracts. Military appropriations are affected by international relations and it is, therefore,

difficult to make any long-range projections for these expenditures. However, the dollar volume of military expenditures has risen over a period of years and indications point to a continuation of this long-term growth. Furthermore, expenditures for electronics, as a percentage of total military expenditures, are expected to increase. The increased output of guided missiles, which use a large volume of electronics components and controls, the growing amount of electronics equipment in aircraft, and the expansion of radar systems are factors which will stimulate this segment of the industry's growth.

The greatly increased volume of output, as indicated above, will result in a continued rapid rise of employment in the industry. Employment will not increase nearly as much as output because technological improvements are enabling the industry to produce greater amounts of equipment per worker employed. Mechanization of processes, simplification of design, adoption of standard parts, and construction of new plants with better layouts are among the factors increasing productivity.

There will be some differences in the rate of growth among the various occupational groups employed in this industry. The growing volume of research and development and the greater application of scientific principles to production processes will result in a relatively larger growth among technical personnel such as engineers, draftsmen, and engineering technicians. The need to maintain and repair the growing amount of machinery and equipment which will be used in this industry will also result in a relatively larger growth in skilled maintenance occupations. However, the number of semiskilled assembly and inspection employees will increase at a slower rate than total employment in the industry.

In addition to job opportunities resulting from the growth of the industry, thousands of job openings will be created each year by the need to replace workers who die, retire, leave the labor force temporarily, or transfer to other industries. This industry has a relatively high turnover rate, due, in part, to the fact that women make up a large proportion of the industry's work force.

Earnings and Working Conditions

Production workers in electronics manufacturing plants (except those employed in manufacturing radio tubes) earned an average of $72.83 a week and $1.83 an hour in July 1956. This compares with average weekly earnings of $79 and average hourly earnings of $1.97 for production workers in all manufacturing industries in the same month. The relatively lower average earnings of workers in the electronics industry reflects the large proportion of semiskilled assembly and inspection workers. Skilled workers in electronics manufacturing usually receive the prevailing wage for their particular trade in the area in which they work.

Little information is available on the earnings of professional and technical personnel in this industry. Information collected from a number of large employers indicates the general range of earnings for selected plant occupations in mid-1956 were:

Assemblers, semiskilled	$1.35 - $1.80
Assemblers, precision	1.80 - 2.30
Machinists	2.10 - 2.80
Tool and die makers	2.30 - 3.10
Instrument makers	2.50 - 2.80
Inspection and testing occupations	1.50 - 2.90

Most workers in the industry receive 2 or 3 weeks' vacation with pay, depending on their length of service. The majority of firms give their employees 6 or 7 paid holidays a year. Almost all electronics workers are covered by both death benefit and sickness insurance plans.

Working conditions in electronics manufacturing compare favorably with those in other industries. Plants are generally clean, well lighted, and relatively free from noise. The work in most electronics occupations is not strenuous. However, the assembly line operations require speed, and the continual repetition of many small tasks creates monotony. Employers make an effort to help relieve this monotony of work by frequent rest periods. Cafeterias, recreational facilities, and social programs are also provided for employees, and some plants provide music during working hours.

Injuries in electronics manufacturing are less frequent and less severe than those in manufacturing as a whole. Shock from high voltage is the most serious hazard, but few workers come in contact with high voltage. Burns from soldering irons, cuts, bruises, punctured fingers, and similar minor injuries are more common hazards.

Employment Outlook for Chemists

Note: This is a preliminary version of a statement prepared for the 1957 edition of the Occupational Outlook Handbook.

Chemistry is by far the largest of the natural science professions. There were about 100,000 chemists in the country in 1956, about 6 to 8 percent of whom were women.

Chemists are concerned with the composition of substances; the physical and chemical changes they undergo; the way they react to each other; the chemical processes required to obtain them from nature or produce them synthetically; and the ways in which they can be put to practical use. In their jobs, chemists must often use mathematical and chemical formulas, make precise measurements, and work with complex laboratory apparatus.

Because of chemistry's vast scope, chemists usually specialize in 1 of the 5 main branches--organic, inorganic, physical, analytical chemistry, or biochemistry. Organic chemists, the largest group, usually deal with carbon compounds--substances chiefly derived from animal and vegetable matter. Inorganic chemists are chiefly concerned with compounds of other elements, including most of the minerals and metals, but may also work with a few substances containing carbon, such as carbonates and carbides, which are usually classified as inorganic. Physical chemists study the quantitative relationships between chemical and physical properties of both organic and inorganic substances--for example, how these substances are affected by electricity, pressure, heat, and light. Biochemists are concerned chiefly with chemical reactions occurring in plants and animals, such as the effects of food or chemicals on plant and animal tissues, and with the influence of chemicals on life processes. Analytical chemists determine the exact chemical composition of substances and thereby provide controls for all types of chemical operations.

Some chemists specialize in a particular industry or product, such as petroleum or plastics. In many instances such work requires a knowledge of more than one branch of chemistry. The specialist in plastics, for example, may have to use physical as well as organic chemistry.

The largest number of chemists are engaged in research and development work. Most of these work on applied research projects aimed at creating new products or improving and finding new uses for existing ones. The others are engaged in basic research, designed to extend scientific knowledge rather than to solve any immediate practical problem. In addition, sizable numbers of chemists are engaged in technical administration, analysis and testing, and teaching. Smaller numbers are engaged in technical sales, production, technical service, consulting, and other activities, such as patent work, technical writing, purchasing raw materials, and marketing research.

Where Employed

Most chemists--about two-thirds according to a 1955 survey by the American Chemical Society--are in private industry, primarily in manufacturing. The chemical industry employs the largest number, but manufacturers of such diverse products as petroleum, food, primary metals, electrical equipment, and rubber also use many chemists. The proportions of chemists in other fields of employment in 1955 were: 15 percent in teaching, 9 percent in government (mostly Federal), 5 percent in research institutes and consulting services, and the remaining small group in a variety of other fields of employment.

Some chemists are employed in every State. However, the greatest numbers are concentrated in the major metropolitan areas of New York, Pennsylvania, New Jersey, Illinois, Ohio, and California.

Training and Other Qualifications

A bachelor's degree with a major in chemistry is usually considered the minimum entrance requirement for beginning chemists, but graduate training is becoming a prerequisite for an ever-increasing number of jobs. More than 40 percent of the chemists answering the American Chemical Society's 1955 survey of its membership had Ph. D. degrees.

Chemists with the bachelor's or master's degree are most likely to find employment in manufacturing industries--particularly in industrial chemicals. Sizable numbers also find opportunities as research workers in government agencies, and many of those with master's degrees are employed as graduate assistants or instructors in colleges and universities while taking further graduate work.

In private industry, chemists with the bachelor's or master's degree usually begin as trainees in laboratory research or development work, in analysis, testing, quality control, technical service, or sales. With additional experience they may advance to positions of greater responsibility and eventually to management positions. Many industrial employers have special training programs for chemistry graduates.

These programs are designed to supplement college training with specific industry techniques and to aid in determining the type of work best suited to the individual.

The doctorate is an extremely valuable asset in the chemical profession. It is considered to be particularly important for obtaining jobs in basic research and essential for a career in college teaching. During the 7-year period from 1949 through 1955, more doctoral degrees were conferred in chemistry than in any other subject field. Those receiving the Ph. D. are most likely to enter research and development work or teaching. In fields such as biochemistry and physical chemistry, in which teaching and research positions are predominant, the doctorate is necessary for a high proportion of the jobs.

Employment Outlook

Employment opportunities for chemistry graduates were very good in 1956. The demand for chemists has increased rapidly since World War II, principally as a result of the rapid expansion of the chemical, petroleum, and other industries employing chemists and the enormous growth of research in these industries. Furthermore, the supply of new chemistry graduates was not sufficient during the early 1950's to meet the growing demand. About 6,800 bachelor's degrees in chemistry and biochemistry were conferred in 1956, slightly more than in 1954 and 1955, but far below the peak number of 10,794 granted in 1950, when many World War II veterans graduated. Moreover, not all graduates with a bachelor's degree in chemistry are available for work in the field. Many continue with graduate work before entering employment in chemistry. Others go on to studies in related fields, such as medicine, or leave chemistry for other reasons.

The long-run outlook is for continued expansion of employment in the profession. It is anticipated that the industries employing most chemists will grow at a rapid rate. In particular, the chemical and petroleum industries, which together employed about one-third of all chemists in 1954, are expected to expand considerably faster than industry in general. In these industries and many others, continued expansion of research and development activities (in which almost half of all chemists are employed) is expected to accompany and contribute to industrial growth. Not only is further expansion anticipated in the research organizations of large companies, but more and more small and medium-sized companies are instituting or expanding research programs which will require the services of chemists. Furthermore, the enormous rise in enrollments anticipated in colleges and universities will result in many openings in teaching.

In addition to those needed for expansion in employment, many chemists will have to be trained each year to replace those who die, retire, or transfer to other occupations. Losses to the profession from death and retirement were estimated to be approximately 1,200 per year in 1955 and will rise slowly in the future.

Along with the expected growth in demand for chemists, a steady increase in the number of chemistry graduates is expected. Assuming that the proportion of college graduates majoring in chemistry and biochemistry remains the same as in recent years, the number of bachelor's degrees conferred in these fields may be as high as 12,000 in 1965--approximately double the number conferred in 1955. The numbers of master's and Ph.D. degrees conferred each year are likely to rise correspondingly a few years later.

Even after allowance is made for the fact that not all chemistry graduates seek work in the field of chemistry, it appears that the number of new graduates at all degree levels available for work in the field could be about twice as great in 1965 as in 1955. Thus, there may be increased competition for the better paying professional entry positions in chemistry. However, the rising demand for chemistry graduates with ability and thorough training will continue to provide favorable opportunities for employment and advancement for such graduates for many years to come.

Employment opportunities for women chemists were favorable in 1956. Furthermore, there has been a recent trend for employers to eliminate salary and other employment differences between men and women chemists of comparable education and experience who are doing similar work.

Earnings and Working Conditions

Chemistry graduates with a bachelor's degree and no experience had a median (average) starting salary of $400 per month, according to a 1956 survey conducted by the American Chemical Society. For graduates with a master's degree but no experience, the median starting salary was $443 and for those with the Ph.D., $600. Women graduates had a lower median salary than men--$375 compared with $407. Some graduates of course earned more and others less than those average figures. Ninety percent of those with bachelor's degrees received more than $330 and 10 percent received more than $435. Starting salaries for 90 percent of the Ph.D.'s were more than $420 per month, and 10 percent of them received more than $639. The median monthly starting salaries for chemists in different fields of employment, according to the American Chemical Society survey, are shown in table 1.

Some idea of the earnings of chemists with many years of experience can be obtained from a 1955 survey of American Chemical Society members. For example, the median monthly salary for male chemists with 24 years of experience was $779. Ninety percent of these experienced men reported earnings of at least $495 per month, and about 10 percent earned $1,434 per month or more. A few in top-level executive positions had much higher earnings than this. The median monthly salary for women chemists with 24 years' experience

was $489--much lower than the comparable figure for men. The difference in salary levels between men and women was greater among chemists with long experience than among those in beginning positions.

In general, a chemist's salary depends on the type of employer for whom he works, the kind of work he does, the extent and quality of his education, and the amount of his professional experience, as well as individual ability. Earnings of chemists are usually highest in private industry, as indicated by the information on starting salaries and also by other surveys. Government agencies generally pay less than private industry but more than educational institutions. A 1951 survey indicated that, in every age group over 30, the private industry employees with only the bachelor's degree had higher average incomes than Ph. D.'s in colleges and universities--suggesting that the type of employer for whom a chemist works is likely to have even more effect on his earnings than his degree. However, within a particular field of employment, Ph. D.'s usually earn considerably more than bachelors or masters with the same amount of experience. Furthermore, earnings levels are higher in some types of work than in others. For example, chemists in administration, technical sales, and industrial research tend to earn more than those in analysis and testing.

Table 1.--Median monthly starting salaries for chemists, by type of employer, 1956

Type of employer	Bachelor's degree	Doctor's degree
Academic	(1/)	$433
Government	$373	(1/)
Contractor for Federal Government	400	(1/)
Research institute	345	(1/)
Industrial	410	610
Biological and pharmaceutical	345	(1/)
Chemical	410	615
Machinery and equipment	410	(1/)
Petroleum	427	600
Plastics	425	610
Rubber	410	(1/)
Other	405	590

1/ Not available.

Source: American Chemical Society.

Employment Outlook for Registered Professional Nurses

Note: This is a preliminary version of a statement prepared by the Women's Bureau for the 1957 edition of the Occupational Outlook Handbook.

Registered professional nurses play an important role in our Nation's medical and health services. They have the primary responsibility for carrying out physicians' instructions and supplementing their services by performing independent nursing functions. Most members of the profession are general-duty nurses, primarily concerned with the care and welfare of patients. The tasks performed by such nurses include administering medicines, ointments, and drugs; observing and reporting temperature, pulse and respiration, and evaluating symptoms and reactions. Nurses also perform such therapeutic tasks as changing dressings, bathing, massaging, and feeding patients; and assist in the education of patients regarding their condition and rehabilitation. A nurse who performs these duties may be employed as a general staff nurse in a hospital, health institution, or health agency, or as a private-duty nurse working for an individual patient. Regardless of the employer, the basic nursing function is the same.

Professional nurses may also specialize in some aspects of patient care and treatment. A nurse specializing in obstetrics, for example, may assist the physician in the delivery room; an instrument nurse may work exclusively in the operating room, handling complex technical equipment in connection with surgery; a nurse in a health agency may provide patient care in a specific area of medical specialization, such as heart disease, cancer, or infantile paralysis.

A growing field of specialization for nurses, which includes duties outside of direct patient care, is in public health education and improvement. Here the emphasis is on prevention of disease and promotion of health and rehabilitation in the community. As an employee of a public or private agency concerned with health programs, the nurse may perform such diverse functions as demonstrating diet plans to groups of patients, helping to prepare charts and booklets on home health and sanitation, or providing information about disease prevention to families of migrant workers.

Nurses in industrial establishments are concerned with the health needs of employees. They may work in health-service departments which provide employees with emergency care, health examinations, and health counseling. These nurses may also assist in developing

programs for the prevention and control of accidents and occupational diseases, and in maintaining sanitation and safety standards in the plant. Nurses in doctors' and dentists' offices work in a team relationship with the physician, caring for patients and performing laboratory and other services for the physician.

Nurses who have college degrees in nursing education or nursing administration may specialize in these areas. Typical duties include teaching such courses as nursing techniques or nursing ethics, serving as executive secretaries on State boards of nurse examiners, or directing the activities of nursing personnel in hospitals.

Where Employed

In 1956, the number of employed professional nurses was about 430,000, according to estimates of organizations in the field of nursing. About 65 percent of the nurses worked for hospitals, schools of nursing, and other institutions; 17 percent for private employers; 8 percent for physicians and dentists in private practice; and the remainder for public health agencies (6 percent) or industrial establishments (4 percent). All branches of the military service employ commissioned nurse officers, and there are some jobs overseas with public or private social, religious, and welfare agencies or with the Federal Government. This occupation is second only to teaching in the employment of professional women. Only 2 percent of all nurses are men. Since the vast majority of communities maintain some health facilities and services, nurses may be employed almost anywhere in the country, provided they can meet the State licensing requirements.

Training and Other Qualifications

Two types of schools, hospital-controlled and collegiate-controlled schools, offer the preparation required for professional nursing. Hospital schools offer 3 years of training, leading to a diploma in nursing. Collegiate schools offer from 4 to 5 years of training leading to a bachelor's degree; some offer a program (open only to college graduates) leading to a master's degree. Of the 1,125 State-approved schools of nursing in the United States in 1956, 83 percent were hospital schools which had an enrollment of 93,530 diploma students, or 85 percent of all student nurses. The 194 collegiate schools had 16,374 students. Newer associate degree programs in the junior and community colleges, usually 2 years in length, currently enroll approximately 1,000 students.

A high school diploma, usually from a college preparatory course, is a minimum requirement for admission to either a hospital or collegiate school. Demonstrated competence in science and mathematics may also be required. Some schools accept only those students

who have graduated in the upper third or half of their class. A few schools accept only students who have completed 2 years of college work. The usual age limits for admission are a minimum of 18 and a maximum of 35 years.

Tuition and other expenses of an education in nursing vary widely among schools of nursing. In most schools, some of the cost of the training is compensated for by services which the student nurse performs for the hospital. Training in hospital schools is usually less expensive than in collegiate schools because the latter include a full college curriculum. Scholarships and loans for training in nursing are available from nursing schools, and various civic and professional organizations, women's clubs, and business groups. The Public Health Service, the Children's Bureau, and the Office of Vocational Rehabilitation of the U. S. Department of Health, Education, and Welfare also make some training stipends available for graduate nurse education or in a specific field of nursing.

Professional nurses must be licensed to practice nursing within a particular State. To obtain a license, the nurse must have graduated from a school approved by the State board of examiners and must pass a State board examination. All State boards use a uniform examination prepared by the National League for Nursing, but each State establishes its own passing grade. A nurse may be registered in more than one State either by examination or by endorsement of a license issued by another State. Examination and endorsement fees range from $5 to $30, depending on the State.

Hospital nursing usually begins with general-duty work from which nurses may advance to progressively more responsible supervisory positions such as head nurse, supervisor, assistant director, and director of nursing services. Advancement is possible for both diploma nurses and degree nurses; but degree nurses who are specifically trained in nursing administration usually progress much more rapidly to the higher administrative and executive positions. Advancement may also come with the acquisition of a clinical specialization in nursing.

A degree in nursing is usually required for entry into the fields of public health nursing and nursing education. Advancement in these fields is to progressively more responsible program planning and consultant work.

Employment Outlook

A shortage of professional nurses, which has existed since the 1940's, was still very much in evidence in 1956 when it was estimated that 70,000 additional nurses were needed. In consequence, practically no age limitations were being placed upon qualified professional nurses

seeking to reenter the labor market. Furthermore, a number of hospitals, which were faced with serious shortages of nurses, established child-care centers, organized special transportation facilities, and created part-time jobs to facilitate the reemployment of inactive nurses.

The shortage of nurses was not due to a drop in the number of active nurses, which has greatly increased in proportion to the population from 55 nurses per 100,000 population in 1910 to 259 in 1956, but rather to a rising demand. Factors which have helped to create this increasing demand include: The expansion of medical services brought about by discoveries of new medical techniques and drugs; the improved economic status of the population; the increasing participation of people in hospitalization and health plans; the growth of preventive medical services; and the changing composition of our growing population with its increasing proportions of very young and older persons who frequently require greater than average medical care.

The demand for nurses is expected to continue to be strong for the remainder of the 1950's and during the early 1960's. In addition to the nurses who will be needed annually to fill new positions, many will be needed to replace those who leave the field. Leaders in the nursing field have estimated that about 5 percent of all professional nurses leave active nursing each year. Furthermore, since 1948 only about two-thirds of the nursing students enrolled each year have remained to graduate. In 1955, it was estimated that nursing schools must admit 58,000 students annually to meet immediate needs and the needs of the next few years. This figure exceeds by some 15,000 the annual student-nurse enrollment in each year since 1948. Some of this demand will be met by reentry--at least on a part-time basis--of inactive nurses, estimated in 1951 to be approximately 40 percent of the total of all registered nurses. (About two-thirds of these inactive nurses were under 40 years of age in 1951.)

Demand for nurses with advanced preparation in such clinical specializations as psychiatric nursing, for nurse educators, supervisors, and administrators, and for public health nurses is expected to rise even faster than for less highly trained personnel through the early 1960's. Factors underlying this demand are the increasing complexity of nursing functions associated with new discoveries in medical knowledge and techniques; the anticipated extension of high quality nursing care to more people; and the growing emphasis on preventive medicine through improved and extended health education of the population. College-trained personnel will undoubtedly continue to have excellent opportunities in these specialties during this period.

Over the long run, the nursing profession is expected to expand not only because of the continuing effect of those factors which have produced the present demand, but also because of the anticipated

population growth. However, the nature of the expansion in the profession is not clear. Some modifications have already been made in the functions of professional nurses, and further studies are being directed toward the most effective utilization of nurses and the best patterns of training for the occupation. A number of junior colleges and some hospitals are experimenting with a 2-year program of training bedside nurses. Graduates of these programs are eligible for the State board examination in nursing. However, the growing demand for highly trained degree nurses for administrative, supervisory, and teaching jobs is expected to continue.

Earnings and Working Conditions

Average salaries of nurses employed in hospitals in 7 metropolitan areas in mid-1956 ranged from $64.50 to $73 a week for general-duty nurses and from $100.50 to $119 for directors of nursing. General-duty nurses earned somewhat less than medical record librarians, physical therapists, and dietitians, whose salaries were closer to those of head nurses. Average straight-time weekly salaries for general-duty nurses in these areas were: Baltimore, $66; Boston, $64.50; Buffalo, $66; Chicago, $73; Cincinnati, $68; Portland (Oreg.), $70.50; and St. Louis, $66.

Professional nurses employed by industrial or business establishments averaged from $61.50 to $84 per week in 18 metropolitan areas during late 1955 and early 1956. Some of the highest salaries in the nursing field are paid to commissioned nurses in the Public Health Service, where annual earnings ranged from $4,063 to $11,745 in 1955. Private-duty nurses earned from $12 to $14 for a basic 8-hour day in most States in 1955.

Although information on starting salaries for all nurses is not available, starting salaries of professional nurses with college degrees compare favorably with those of women in other professional occupations, according to a survey of June 1955 women college graduates conducted by the National Vocational Guidance Association and the Women's Bureau of the Department of Labor. Professional nurses averaged $3,438 annually, according to this survey; and these earnings were exceeded only by those for mathematicians and statisticians, who averaged $3,848, and for chemists, who averaged $3,900 annually.

The 1956 survey of hospital nurses in 7 metropolitan areas indicated that a majority of nurses worked a weekly schedule of 40 hours and received equal time off or straight-time pay for overtime work. Almost all nurses received extra pay for evening or night shifts. Almost all nurses received at least 2 weeks of paid vacation after a year of service.

Estimates of Worker Trait Requirements for 4,000 Jobs

Estimates of Worker Trait Requirements for 4,000 Jobs, a recent publication of the U. S. Department of Labor's Bureau of Employment Security, presents a new approach to the old counseling and placement problem of relating worker qualifications or characteristics to job requirements. The publication provides estimates of the interests, temperaments, aptitudes, training times, and physical capacities required for a wide variety of specific jobs. These estimated requirements are based on the judgments of experienced technicians in occupational analysis. Definitions in the Dictionary of Occupational Titles served as the basic source of job information for rating purposes.

Heretofore, information on worker trait requirements has been available for only a limited number of jobs. This new volume supplies information on many areas not previously covered. The 4,000 jobs were selected to represent the major occupational fields, industries, and levels of complexity. It is anticipated that the coverage will be further expanded in the future.

The components or aspects of job requirements rated are those deemed to contribute most to the dual objective of assuring workers consideration for all suitable jobs which are available and of assuring employers selection from the largest number of available qualified workers. The rating scales and guides used in the rating process are included in the publication for the use of job analysts and other persons interested in understanding the process or in applying it to additional jobs or to jobs in particular establishments and in particular localities.

The training time component was divided into two aspects for rating purposes: (1) the degree of general educational development required (including reasoning, mathematical, and language development); and (2) the amount of specific vocational preparation required.

Aptitudes were defined as the specific capacities or abilities required of an individual in order to facilitate the learning of some task or job duty. The aptitude component consisted of eleven aptitudes, identified as intelligence, verbal, numerical, spatial, form perception, clerical perception, motor coordination, finger dexterity, manual dexterity, eye-hand-foot coordination, and color discrimination. Each job was rated for each of these aptitudes. The degree of each aptitude required was indicated by use of the following 5-level rating scale:

1. The highest 10 percent of the working population.
2. The upper third exclusive of the highest 10 percent.
3. The middle third of the working population.
4. The lower third exclusive of the lower 10 percent.
5. The lowest 10 percent of the working population.

For example, using this scale, jobs judged to require the intelligence possessed by the highest 10 percent of the working population were rated (1) for this aptitude.

Twelve "temperaments," or more specifically, 12 different types of occupational situations to which workers must adjust, were identified from a study of job descriptions and adopted to reflect worker characteristics required for the jobs. They are described as situations involving: Variety and change of duties; repetitive, short-cycle operations; work under specific instructions; direction, control, planning of activities; dealing with people; working in isolation from others or alone; influencing people; performing under stress; application of sensory or judgmental criteria; application of measurable or verifiable criteria; interpretation of feelings, ideas, facts; and attainment of set limits, tolerances or standards. The two temperaments judged to be more important than any of the others were selected for each job and designated in the "estimates."

Interests, as used in the study, were defined as preferences for certain types of work activities or experiences, with accompanying rejection of contrary types of activities or experiences. Five opposing pairs of work situations reflecting interest factors formed the basis for rating each job for the two most significant interests required for success and satisfaction on the job. They are described as follows:

1. Situations involving a preference for activities dealing with things and objects.	vs.	6. Situations involving a preference for activities concerned with people and the communication of ideas.
2. Situations involving a preference for activities involving business contact with people.	vs.	7. Situations involving a preference for activities of a scientific and technical nature.
3. Situations involving a preference for activities of a routine, concrete, organized nature.	vs.	8. Situations involving a preference for activities of an abstract and creative nature.

4. Situations involving a vs. preference for working for people for their presumed good as in the social welfare sense, or for dealing with people and language in social situations.

5. Situations involving a vs. preference for activities resulting in prestige or the esteem of others.

9. Situations involving a preference for activities that are nonsocial in nature, and are carried on in relation to processes, machines, and techniques.

0. Situations involving a preference for activities resulting in tangible, productive satisfaction.

Physical capacities required for the performance of various occupations were expressed as activities involved in the occupation. Jobs were rated for characteristic activities by using the following list of six different types:

1. Lifting, carrying, pushing, and pulling (strength) involved in: Sedentary work; light work; medium work; heavy work; or very heavy work.
2. Climbing.
3. Stooping, kneeling, crouching, and crawling.
4. Reaching, handling, fingering, and feeling.
5. Talking and hearing.
6. Seeing.

Jobs were also rated for working conditions factors by selecting and designating the types of physical surroundings in which the work was done as follows:

1. Inside or outside.
2. Extremes of cold plus temperature changes.
3. Extremes of heat plus temperature changes.
4. Wet and humid.
5. Noise and vibration.
6. Hazards.
7. Fumes, odors, toxic conditions, dust, and poor ventilation.

Since the information provided in the publication represents the accumulated analyses and judgments of experienced occupational analysts and technicians and is based on definitions which are nationwide composites of many descriptions of jobs as they exist in different localities and firms, it must remain open for additional judgments of persons operating in specific local situations. Users are encouraged to adopt the approach of this study in their own analysis of job requirements

and in the process of identifying and evaluating worker characteristics. To the extent that requirements and characteristics can be described in the same terms, the relationships between them will become more apparent and better understood.

The estimates constitute one aspect of a larger project, the Functional Occupational Classification Project (FOCP), designed to provide an occupational classification structure based on relationships of worker characteristics required by different occupations. The resultant structure, it is hoped, will be more meaningful and more useful than any developed to date for placement and employment counseling.

Source: U. S. Department of Labor, Bureau of Employment Security, Estimates of Worker Trait Requirements for 4,000 Jobs. For sale by U. S. Government Printing Office, Washington 25, D. C. Price $2.25.

Now Available

SCIENCE AND ENGINEERING IN AMERICAN INDUSTRY--FINAL REPORT ON A 1953-1954 SURVEY (Bulletin NSF 56-16)

Report on the Nation's industrial research and development. Part I, based on a sample of 11,600 companies, contains estimates of research and development costs and personnel. Part II, based on interviews with officials of 200 large corporations, deals with factors influencing the level of company expenditures for research and development.

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. Price 70 cents.

What Good Is a High School Diploma?

The contribution of education to the lives of young people cannot be measured in dollars alone. Everyone knows that many intangible values and satisfactions stem from one's increased knowledge and the full development of one's abilities. Nevertheless, the economic values of schooling cannot be ignored by young persons planning their vocational careers. A few of these measurable values are set forth in a Fact Sheet issued jointly by the U. S. Departments of Labor and Health, Education, and Welfare.

Most good jobs today require at least a high school education. The Fact Sheet points out that at least 4 years of schooling at the high school level is required for each of the 71 occupations listed by the Labor Department as shortage occupations. A high school education is required or preferred for 52 out of 85 jobs suitable for young people of high school age listed in the Job Guide for Young Workers, published by the Bureau of Employment Security. Furthermore, a study of 1950 census data showed that among young male workers from 22 to 24 years of age, 70 percent of all sales and clerical workers, 85 percent of all professional and technical workers, and even 45 percent of all craftsmen and service workers had finished high school.

Ten years ago, 65 percent of young people 16 and 17 years of age were enrolled in school; today 77 percent are enrolled. Ten years ago 40 percent of young people in school stayed to graduate; today 55 percent stay to graduate. Those without a high school education will, therefore, find it increasingly difficult to compete with those who have graduated from high school.

Another important fact disclosed by the census data is that among men 25-64 years old, those with college educations were least likely to be unemployed; those with an eighth grade education or less, most likely. Furthermore, among young men who started high school, unemployment rates were half again as high for those who did not finish as they were for those who graduated.

The more education a person has, the higher his income is likely to be. The data show that persons who stay in high school are likely later to earn an additional $238 yearly for each year spent in school through the eleventh grade. Those who stay to graduate are likely to gain $466 more in yearly income. By the time a man reaches his peak earning period (from 45 to near 64 years), the high school graduate makes 30 percent more than the man who started but dropped out. It is estimated that the high school graduate, during his adult years, will receive $50,000 more than the eighth grade graduate and $30,000 more than the high school dropout!

In the interpretation of these figures, the reader must, of course, remember that persons who stay in school and graduate, on the whole, represent the more able group and that differences in earnings are affected by differences in abilities. However, the fact that a high school education is a requirement for many good jobs warrants serious consideration on the part of students with sufficient abilities to benefit from additional schooling.

Now Available

REPORTS ON THE OLDER WORKER

These reports cover the results of an extensive program of fact finding and demonstration projects conducted on a coordinated basis by the U. S. Department of Labor's Bureau of Labor Statistics, the Bureau of Employment Security, and the Women's Bureau. They cover the following:

Job Performance and Age: A Study in Measurement, BLS Bulletin No. 1203--describes the methodology and results of studies of comparative performance of workers by age groups in the men's garment and shoe industries. Price 45 cents.

Pension Costs in Relation to the Hiring of Older Workers, BES Bulletin No. E150--describes the findings of a select committee of pension, insurance, and banking experts concerning the comparative costs of hiring older workers and the validity of the argument that such costs make the hiring of new older workers prohibitive. Price 25 cents.

Counseling and Placement Services for Older Workers, BES Bulletin No. E152--describes the extent and effects of age restrictive hiring practices and the results achieved and methods used in 7 demonstration offices in a successful effort to increase job opportunities for older workers. Price 50 cents.

Older Worker Adjustment to Labor Market Practices: An Analysis of Experience in Seven Major Labor Markets, BES Bulletin No. R151--describes detailed findings on the characteristics of the older unemployed and the patterns of employment, unemployment, hires, and separations in seven major metropolitan labor markets--Worcester, Philadelphia, Miami, Minneapolis-St. Paul, Detroit, Los Angeles, and Seattle--during 1955 and 1956. Price $1.25.

For sale by the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C.

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